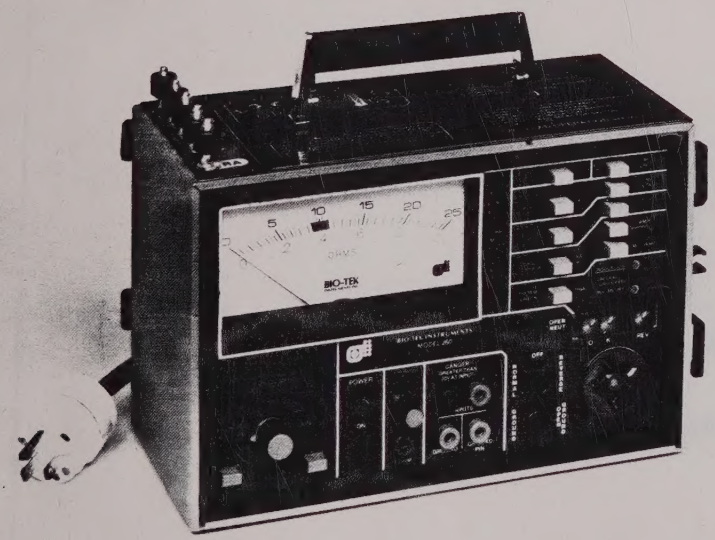
BIO-TEK INSTRUMENTS, INC.

OPERATOR MANUAL

MODEL 260 ELECTRICAL SAFETY ANALYZER



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TARZANA REGIONAL MEDICAL CENTER
18321 CLARK
TARZANA, CALIF. 91356

Model 260
Electrical Safety Analyzer
Operating & Service
Manual

TARZANA REGIONAL MEDICAL CENTER
18321 CLARK
TARZANA, CALIF. 91356

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1.1 General

The Model 260 Electrical Safety Analyzer is a portable, solid state instrument designed to perform all of the routine tests required for determining if electrically-operated devices, conductive surfaces and receptacles are electrically safe for use according to recognized national safety standards.

The Model 260 has an internal resistance that simulates the lowest impedance which the human body offers to the flow of electrical current. By simulating the human body, the 260 test results indicate the actual levels that would pass through the body if it were to offer a path for leakage currents.

The Model 260 Electrical Safety Analyzer is a prescision device designed to make electrical safety testing uncomplicated and rapid. Simple push button operation, with an auto-ranging display, makes data collection simple and accurate. Universal ECG jacks, for plugs and snaps, facilitate ECG testing. Other features which increase user efficiency include: compact size, self-check circuitry, modular design for discrete servicing and back panel accessory storage.

1.2 Applications

The 260 provides precise data on various electrical parameters that will determine if a device is electrically safe for use.

As a quality assurance test instrument the Model 260 provides a means to test devices before they are placed in service. A wide range of testing capabilities help indicate if the device will be safe during normal operating conditions as well as under worst case conditions. In addition, certain electrical specifications can be tested according to the manufacturers specifications.

The 260, if incorporated into a routine safety program, will provide long-term and immediate benefits. Electrical degradation of a device will become readily evident from records of test results obtained during each electrical safety survey; thus, instruments can be removed from service before they become an electrical hazard.

In addition, this data will be useful whenever additional purchases of equipment are being considered. By reviewing the amount of repair time required for a given instrument, along with its safety record, it can be decided if repurchasing is cost effective.

1.3 Testing Capabilities

The Model 260 is designed to perform tests recommended by the majority of nationally recognized agencies involved in issuing safety standards. (AAMI frequency response and load)

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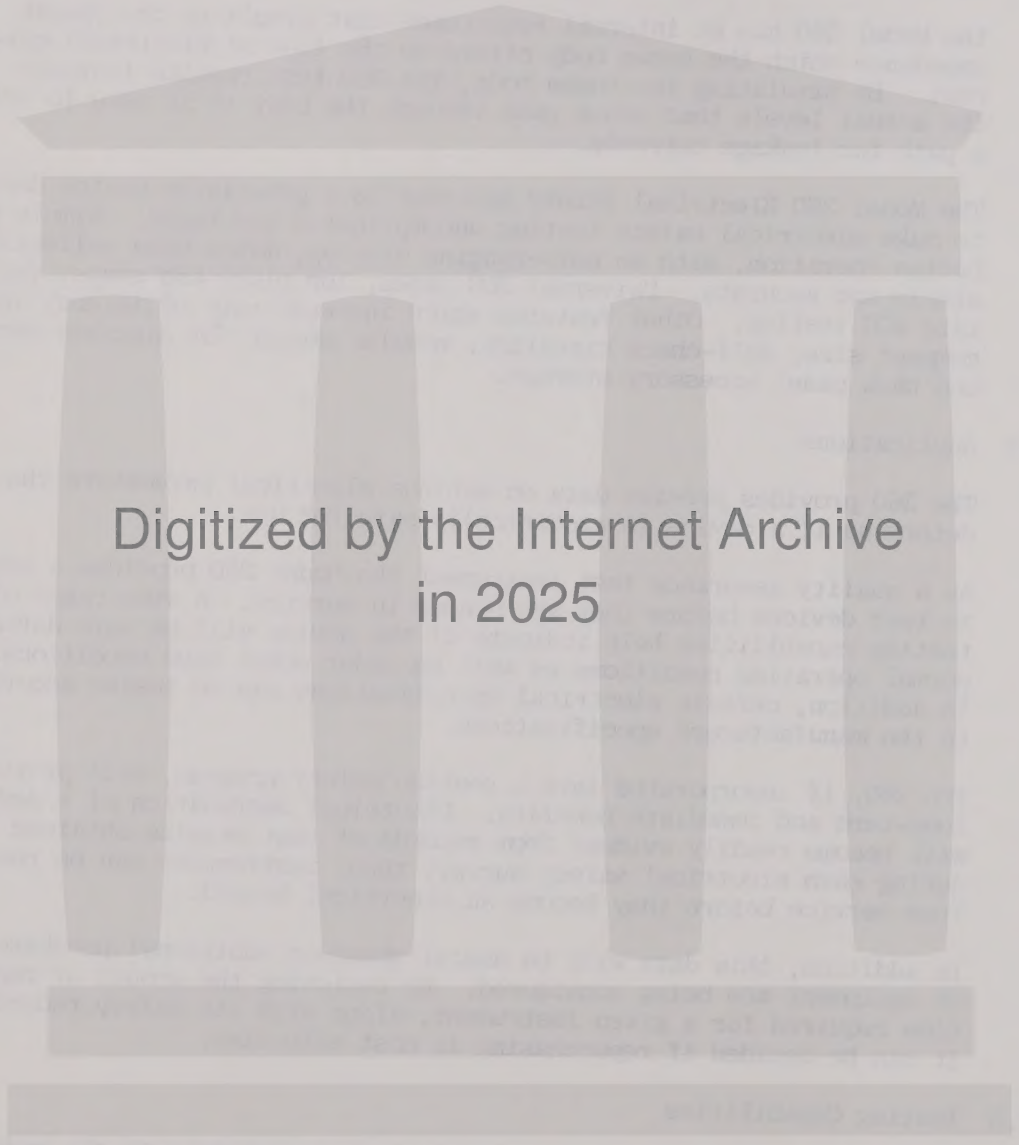
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Receptacles

.Determine the polarity of each receptacle;
.Determine if each receptacle is grounded;
.Determine if the metal face plate of the outlet is grounded;
.Measure the potential differences and resistances between the grounding pole of one receptacle and the grounding pole of any other receptacle;
.Measure the potential differences and resistances between the grounding pole of a receptacle on one branch circuit and the grounding poles of receptacles on a different branch circuit fed by the same distribution panel;
.Measure the potential differences and resistances between the grounding pole of each receptacle and the grounding point that services them.
.Automatically tests neutral to ground resistance of a receptacle.

Portable Devices

.Measure the potential differences between a device's exposed conductive surfaces and the grounding point that services it;
.Measure the resistance between a device's exposed conductive surfaces and chassis, and the grounding pin of the plug;
.Automatically tests resistance of power conductors to ground. (Part of the systems check.)
.Measure leakage currents from a device when it is:

grounded with normal polarity
grounded with reversed polarity
ungrounded with normal polarity
ungrounded with reversed polarity

*all the above configurations may also be performed with the open-neutral test.

Equipment With Leads

.Measure leakage currents from isolated patient leads;
.Measure the leakage currents from non-isolated patient leads;
.Measure the leakage currents between leads;
.Measure potential differences between leads;
.Measure resistances between leads and exposed conductive surfaces;
.Measure isolation of patient leads using 120 volts.
.Measure combined lead leakage from all leads.

Fixed Equipment

.Measure the potential difference between exposed conductive surfaces of fixed equipment serviced by the same distribution panel;
.Measure the resistance between exposed conductive surfaces of fixed equipment and the grounding pole of a power receptacle serviced by the same distribution panel;

.Measure the potential differences between exposed conductive surfaces of fixed equipment serviced by different distribution panels;
.Measure the resistance between exposed conductive surfaces of fixed equipment serviced by different distribution panels;
.Test for continuity of ground between each grounding point and the exposed conductive surfaces of fixed equipment it services;
.Measure leakage currents from fixed equipment.

Conductive Surfaces

.Measure the potential differences between the grounding pole of one of the receptacles and each exposed conductive surface;
.Measure the resistance of the grounding cord servicing each exposed conductive surface;
.Measure the potential difference between each conductive surface located in a given area;
.Measure the resistance between each grounding point and the exposed conductive surface it services;
.Measure the leakage currents from exposed conductive surfaces.

1.4 Establishing Safety Standards

Due to variation in acceptable standards presently being suggested and enforced by the various agencies, organizations, and institutions, this manual does not include suggested acceptable levels for each test procedure.

Each test should be perfomred in accordance with the test procedures presented in this manual, but refer to your safety programs specifications to determine if the results obtained are acceptable, or if the item tested should be repaired or replaced.

If you have questions concerning standards, write to the appropriate agency, or write to Bio-Tek Instruments for information, specifying the application and area of concern. Bio-Tek Instruments has a manual on safety testing and standards, available at a nominal cost.

1.5 Record Keeping and Tagging

Bio-Tek Instruments has a complete Record Keeping and Tagging System available that will fit into any program. Write or call the Sales Department, Bio-Tek Instruments, Inc., One Mill Street, Burlington, VT 05401, 800-451-5172 for information.

1.6 Annual Calibration and Instrument Check

We recommend that each Model 260 be recalibrated annually. Calibration instructions are included in this manual in Section 11.0. If the purchaser does not possess the necessary equipment for proper recalibration, return the Model 260 to the factory, prepaid with a purchase order for recalibration traceable to the National Bureau of Standards.

For calibration, the Model 260 should be shipped prepaid to:

Service Department
Bio-Tek Instruments, Inc.
One Mill Street
Burlington, VT 05401

via Parcel Post or UPS and insured for $750.00

1.7 Unpacking Instructions

1. Unpack the shipping carton.

2. Verify contents of shipping carton for the following:

   a. Model 260 Electrical Safety Analyzer
   b. Leads (1 x red lead and 1 x black lead) with banana jacks on each end.
   c. Red Pomona probe
   d. Large clamp
   e. Ground Adapter
   f. 2 x manuals
   g. Calibration sheet
   h. Warranty card

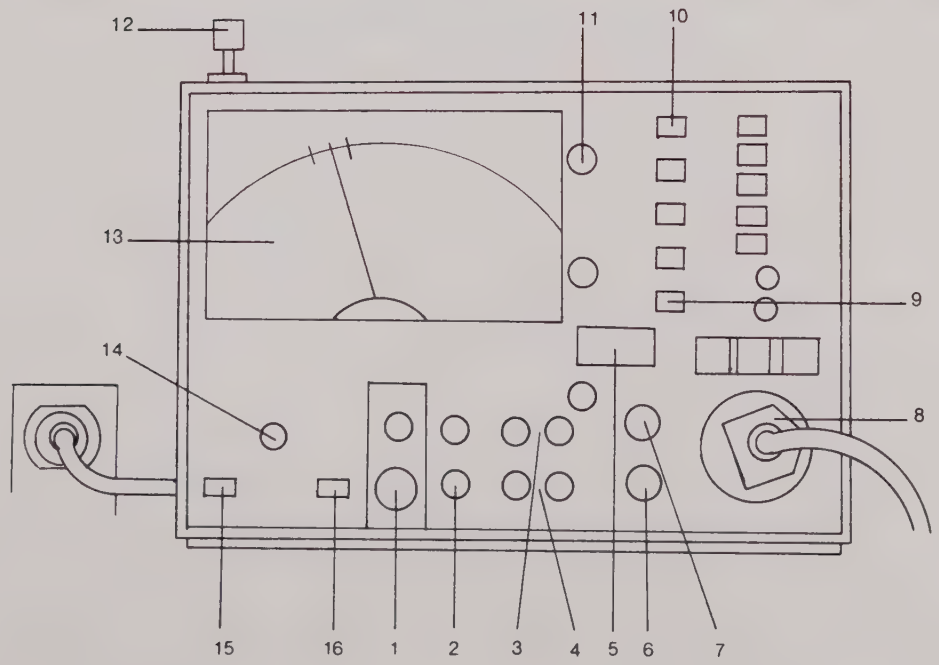
Please Note: Call Bio-Tek Instruments immediately if unit does not meet your visual or operational inspection. Call Service Department at 800-451-5172.

2.0 DESCRIPTION

2.1 Front Panel

1. ON/OFF - Neon light indicates that Model 260 is properly powered.
2. Ohms Calibration - 1 ohm reference for resistance measurements.
3. Signal Inputs - The signal to be measured is applied between red and and black inputs.
4. Ground Connection - References input to ground.
5. Open Neutral - Disconnects neutral power conductor at test receptacle.
6. Ground Switch - Simulates broken ground wire for device under test.
7. Polarity Switch - Reverses polarity of Model 260 test receptacle.
8. Test Receptacle - Hospital grade receptacle brings test point to front panel.

MODEL 260 FRONT PANEL



9. Systems Check - Concurrently performs the following tests.

   Insulation Test - Indicates whether the insulation of equipment's neutral/ground and power/ground is over 1 megohm.

   Internal Calibration Test - 10μA reference

   Receptacle Test - Verifies proper ground, power, and polarity.

10. Function Selectors - The selectors control the following tests: ECG leak leakage, AC/DC, volts (including line voltage), Ground Wire Resistance, Power Ground to Neutral Resistance, Leakage Current, and Current Consumption.

11. Multiplier - Autoranging LEDs indicate measurement range.

12. Universal ECG Jacks - Allow attachment of ECG snaps or bananas. Color coded overlay.

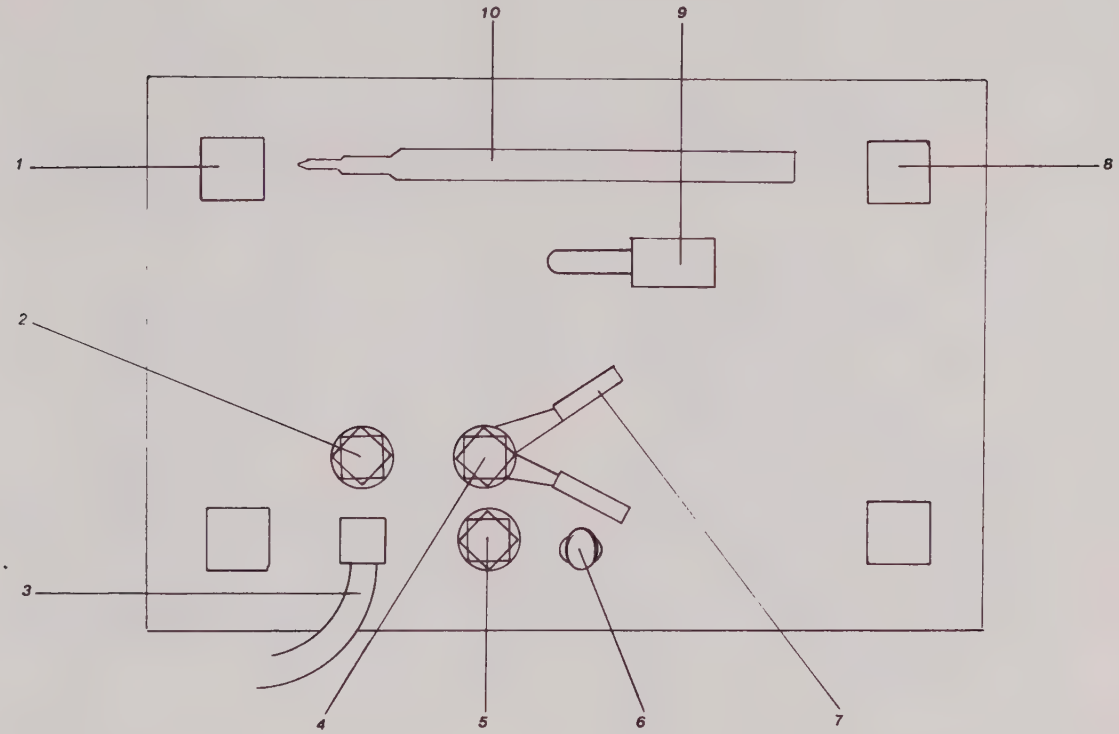
13. Analog Meter Display - $3\frac{1}{2}$ inch meter, with two ranges, overload protection and ±2% accuracy.

14. Lead Select Control - selects individual leads for individual lead leakage and isolation and between lead leakage.

15. Combined Lead Leakage - Shorts all individual lead leakage for combined reading.

16. Lead Isolation - Momentary introduction of 120 volts through 300K limiting resistor.

MODEL 260 BACK PANEL



2.3 Back Panel

1. Cord Wrap: provides storage for the line cord and acts as feet for using the Model 260 on its back.

2. Fuse Holder: 1 amp fuse for Model 260 power supply.

3. Line Cord: heavy duty line cord.

4. Fuse Holder: 15 amp fuse for front panel receptacle.

5. Fuse Holder: $\frac{1}{4}$ amp fuse for ohms circuit protection.

6. Chassis Ground Connector: knurled nut provides easy connected to chassis of Model 260.

7. Large Clamp: for attaching lead to equipment under test. Clips onto ohms circuit fuse holder.

8. Cord Wrap: provides storage for the line cord and acts as feet for using the Model 260 on its back.

9. Ground Adapter: banana jack-to-ground-pin adapter. Clip on.

10. Probe: red pomona probe for leakage current testing. Clip on.

2.4 Optional Equipment

Most hospital operating rooms are equipped with explosion proof receptacles. Bio-Tek offers Adapter Cords to allow the Model 260 to effectively test these areas. All major manufacturers of receptacles are available from stock.

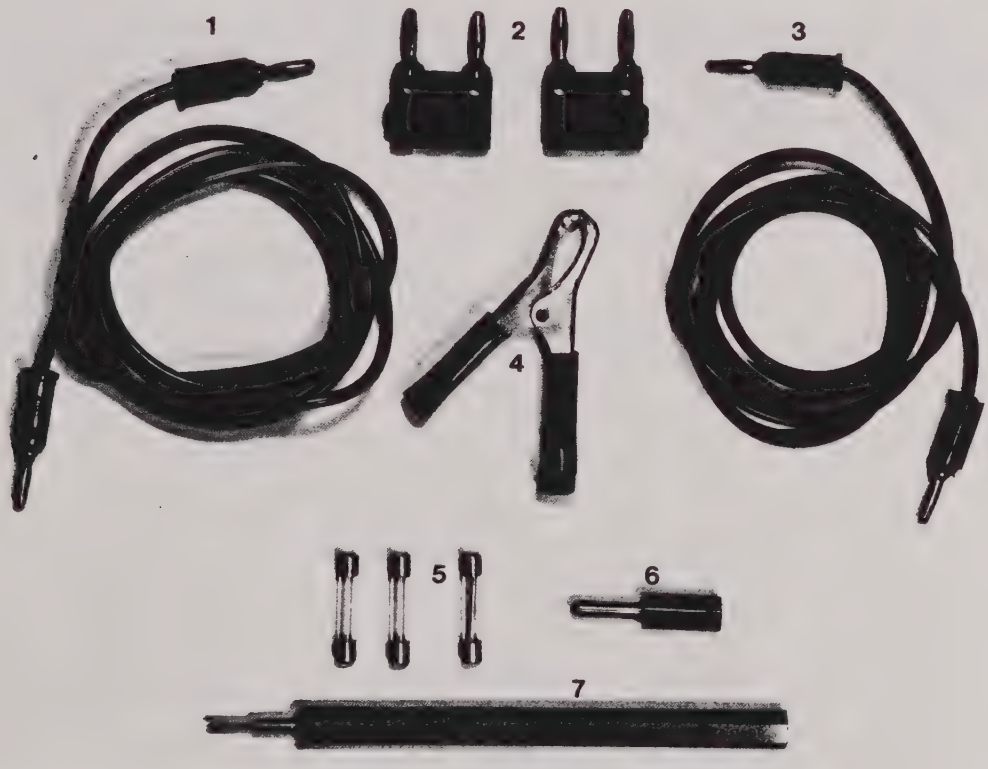
Model	Manufacturer
NF23/1, NF23/2	Hubbell
NF24/1, NF24/2	Crouse-Hinds
NF25/1, NF25/1	Appleton

The "-1" units are equipped with a male explosion proof connector and a female three pring plug.

The "-2" units are eqipped with female explosion proof type connector and a male three prong plug.

2.5 Accessories

Shown below are the accessories which are supplied with the Model 260. Part numbers are listed for use in ordering any extra accessories desired.



1	2	3	4	5
Red Lead	Shorting Bars	Black Lead	Large Clamp	Spare Fuses
48016	48037	48017	48003	46001

6	7
Ground Adapter	Red Probe
48005	48001

2.6 Optional Accessories

Model CC3 Carrying Case

The Model CC3 is a custom carrying case designed to conveniently and safely transport your Model 260 and its accessories. The exterior is constructed of durable thermoplastic with a shock-absorbent polyfoam interior.

This tough aluminum reinforced case comes with a full five year guarantee against all defects in materials and craftmanship. Consult the current Bio-Tek price list for its price. Please note that when ordering the Model CC3, you state which instrument you are transporting in it.

Features:

- Heavy duty ABS exterior
- Shock absorbent polyfoam interior
- Rugged steel-core handle and draw bit lock
- All edges and corners reinforced with aluminum

3.1 SPECIFICATIONS

Leakage Current

Microamps: 0-25, 0-250, 0-2500μA

Accuracy: ±2% of full scale

Millivolts: 0-25, 0-250, 0-2500mV

Accuracy: ±2% of full scale

Input Impedance: 1000 ohms ±1% (per AAMI test load)

Frequency Response: DC to 100K (per AAMI response curve)

Current

Ampheres: 0-20A (rated range)

Accuracy: ±2% of full scale

Automatic Insulation Test: Pass/Fail LEDs, indicate acceptable neutral/ground and power/ground resistances (for equipment under test). Standards are based on > or < megohm

Accuracy: ±15%

Volts

Volts Range: 0-2.5, 0-25, 0-250

Accuracy: ±2% of full scale

ECG Lead Leakage/Isolation

Leakager Current: 0-25, 0-250, 0-2500μA

Lead Isolation: 120 volts through 300K ohm limiting resistor.

Current Carrying Capability: 20 amps, 120 volts

Open Neutral Test: to UL544 Requirements.

Display: 4½" prescision analog meter, full one year warranty.

Power Requirements: 120 volts/60 hz.

Systems Check:

Calibration: 10μA source

Receptacle: Power, Ground, and polarity verification of wall receptacle.

Insulation Test: Automatic LED indication of equipment's power/ground, neutral/ground insultation. Standard is > 1 megohm.

Resistance: 1 ohm calibration standard (test done in resistance operating mode).

Physical Characteristics

Case: 10 x 6 x 4.5" (244 x 165 x 114mm) electrostatic epoxy finish

Weight: 4 lbs. (1.8kg)

Carrying Case: Model CC3, ABS plastic with 5 year warranty.

Environment: Operating Temperature 0^{o} - 40^{o} C;
Storage Temperature: -25^{o} - 50^{o} c; humidity to 90% R.H.

Accessories: Large probe, clamp, ground adapter, 2 x 5' lead, spare fuses, 2 instruction manuals.

Warranty: Full warranty on all parts and labor (see warranty card for elaboration).

Calibration: Traceable to the National Bureau of Standards (NBS) Recommended recalibration once a year. Send unit to:

Service Department
Bio-Tek Instruments, Inc.
One Mill Street
Burlington, VT 05401

802-863-1880

4.0 SYSTEMS CHECK - General

The Model 260's systems self-check insures the accuracy and operators safety during your electrical safety testing. This should be done before each day's testing and upon connection to each new outlet.

4.1 SYSTEMS CHECK - Specific

Plug the Model 260 into an outlet and plug the equipment under test into the model 260. Press Systems check. This will verify the following:

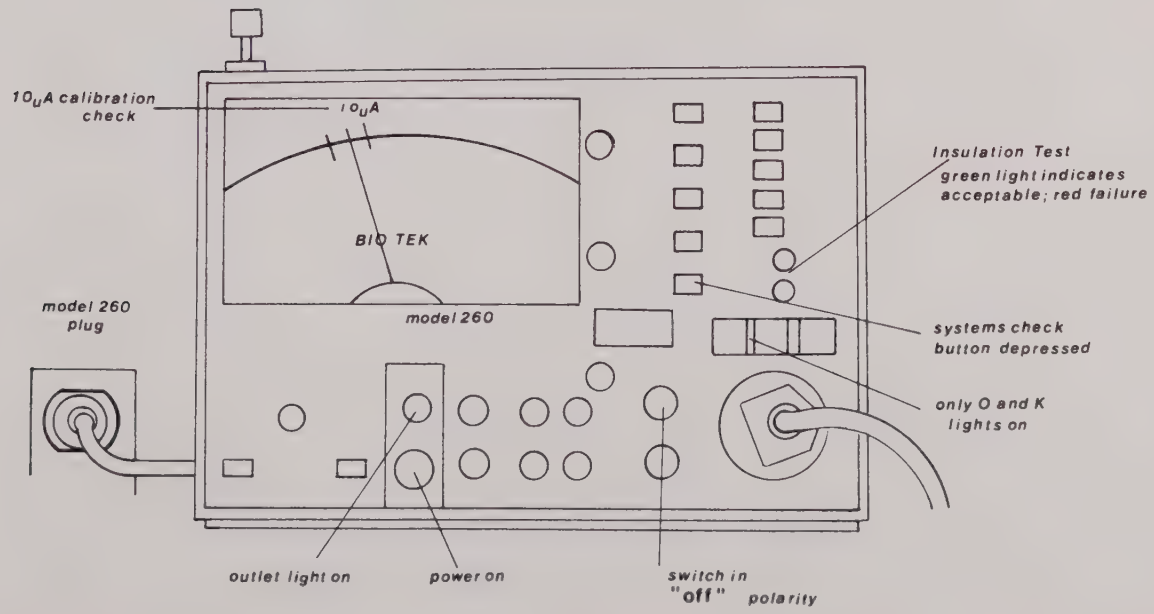
1. Analog display should read 10μA. This is controlled by an internal 10mV reference. Insures calibration of Model 260.

2. Tests the receptacle to which the model 260 is connected, for power, ground, and polarity.

Note: The receptacle test is invalid when in an Isolated Power System area. An explanation is contained in section 5.1.

3. Insulation test is automatically done on power cord of equipment under test. This indicates whether power/ground and neutral ground resistance is over 1 Mohm. Red LED indicates Failure; green LED indicates Pass.

SYSTEMS CHECK



4.2 System Check Problem Analysis

1. Meter does not read 10μA.

   A. The meter may need to be mechanically adjusted. Turn the Model 260 off and mechanically adjust the pointer to zero using the set screw on the meter face.

   B. If the meter now reads out of the red band around 10μA, the unit may be malfunctioning or the meter movement may be damaged. It is recommended that the unit be returned to the factory at the address below.

      Bio-Tek Instruments, Inc.
      Service Department
      One Mill Street
      Burlington, VT 05401

      Return the unit prepaid and insured for $750.00.

2. One or both of the Insulation check lights are red.

   A. Check to be sure that the polarity switch for the front receptacle is in the "OFF" position. If the receptacle is powered, the indicators will not work properly.

   B. Unplug the device under test. If the indicators are still red, the unit is probably defective and should be returned to the factory. If unpluging the device under test returns the lights to green, the device under test has an Insulation failure which should be double checked with an ohm meter.

3. Neon lights indicate status other than proper "OK" configuration.

   See section 5.1 for analysis.

5.0 RECEPTACLE TESTING

5.1 Receptacle Testing

The Model 260 allows comprehensive testing of ground referenced power system receptacles. Receptacles are tested for neutral to ground resistance, polarity, ground and power. Resistances and potential differences between two receptacles can also be tested.

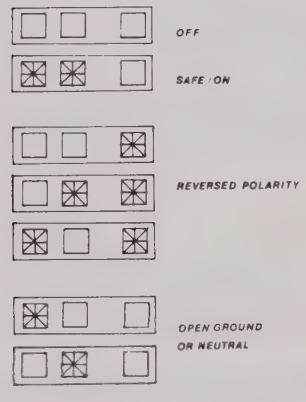
Note: Polarity testing and Neutral to Ground Resistance testing are not valid for an Isolated Power System (IPS). This is due to the fact that in an IPS there is no "hot" or "neutral" nor is either side of the power outlet connected to earth ground as in a conventional ground referenced power system.

1. Testing receptacles for power, ground, and polarity.

   A. Plug the Model 260 into a receptacle.

   B. Push the " Systems Check " button.

   C. The neon lights should read "O.K.". If not, refer to the neon light "Read-Out" chart below.



2. Neutral to Ground Resistance Testing

   A. Plug the Model 260 into a receptacle to be tested.

   B. Push the "Ground Wire Resistance" button.

   C. Push the "Neutral to Ground Resistance" button.

   D. Subtract .20 ohms form the Neutral to Ground reading. The .20 ohms is the approximate resistance of the internal connectors and wire of the Model 260.

3. Receptacle to Receptacle Testing of Resistance or Potential Difference.

   A. Use the single lead set up.

SINGLE LEAD

Place Shorting bar between black input jack and green ground jack.

Connect single red lead to red input jack.

   B. Plug the Model 260 into a receptacle.

   C. Attach the ground adapter to the red lead which is connected to the Model 260.

   D. Plug the ground adapter into another receptacle.

   E. Put Ground switch on "GROUND".

   F. Push the "Ground Wire Resistance" button. The resistance between the receptacle that the Model 260 is plugged into and the receptacle with the red lead input is measured.

   G. By pushing "Chassis Leakage", the potential difference in millivolts is measured.

4. Line Voltage

   A. Plug Model 260 into wall receptacle.

   B. Press "Volts" and "Line Voltage" selectors.

   C. Read Volts directly on meter with the following ranges: 0-2.5, 0-25, and 0-250V.

6.0 PORTABLE DEVICE TESTING

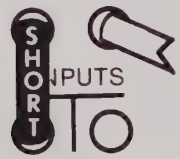
6.1 Introduction

This section describes how to test devices which have an accessible three prong, 15 amp plug. If the devices are permanently wired, refer to Section 8.0 for testing procedures.

6.2 Set-Up

1. Single lead measurement:

SINGLE LEAD



Place Shorting Bar between black input jack and green ground jack.

Connect single red lead to red input jack.

Note: These shorting bars connect one side of the measuring system to earth ground during chassis leakage measurements and to the 260 receptacle ground pin during ground wire resistance measurements.

2. Plug the Model 260 line cord into a receptacle.

   Note: If the devices to be tested are located in an Isolated Power Systems Area, refer to Section 7.0 for set-up instructions.

3. Push the "Systems Check" button. Verify that:

   A. Analog Meter reads: 10µA.

   B. "Receptacle Check" neons read "OK".

      Note: The receptacle test is invalid when testing in an Isolated Power System Area. An explanation is contained in Section 5.1.

   C. Insulation Test Indicators should be illuminated green.

If any of the above do not occur, refer to Section 4.2 for analysis.

4. Plug the line cord of the device under test into the 260 receptacle.

5. If the device has ECG leads, perform the following test prior to attaching these leads:

   A. Push "ECG Lead Leakage" button.

   B. Push "ECG Lead Isolation" button.

      WARNING: The Universal ECG Jacks have 120 volts through 300K applied when the ECG "Lead Isolation" button is pushed. Do not touch the jacks during measurement since current of up to 500 microamps can pass through the ECG jacks.

   C. Record the reading on the display (which should be between 1.0 and 10.0 microamps) on the inspection form as the "Isolation Factor". This reading should be subtracted from the ECG lead isolation measurements which will be made in Section 6.6.

6. If there are ECG leads, attach them to the Universal ECG Jacks by snapping them onto the top of the jack or by sliding the pins into the holes and screwing down the adapter nut.

7. Plug the single red lead into the red input jack on the Model 260. Place the other end of the red lead into the "1 ohm" jack to the left of the input jacks. Push the "Ground Wire Resistance" button and adjust the "Calibration" knob so the meter reads "1" on the ohms scale. Unplug the red lead from the "1 ohm" jack and plug this into the large clamp.

6.3 Chassis Leakage Measurement

1. Push the "Chassis Leakage" button.

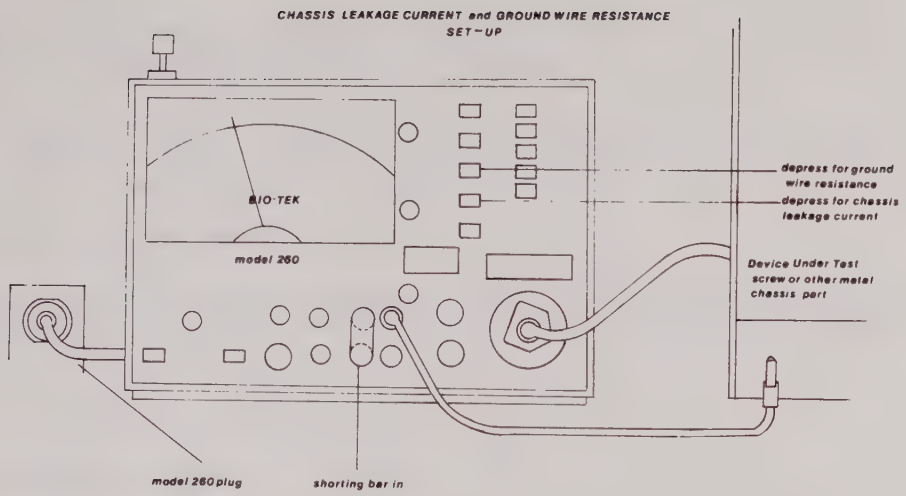
2. The display indicated leakage is in either microamps or millivolts. Take readings in each of the following power configurations:

   Normal Polarity - Ground
   Reversed Polarity - Ground
   Reversed Polarity - No Ground*
   Normal Polarity - No Ground*

   Please Note: All tests can also be done with Open Neutral.

   *If the "Danger" light is activated, place the polarity switch on center "OFF" position. Unplug the device, properly tag and remove from service.

3. The operator may wish to measure the seperate A.C. and D.C. leakage current components. This can easily be accomplished by pressing the "A.C." button, in order to read only A.C. leakages. To obtain a D.C. leakage current reading, simply subtract the A.C. leakage current from the normal leakage current measurement.



6.4 Ground Wire Resistance Measurement

1. Place the "Polarity Switch" in the center "OFF" position.

2. Push the "GRD Wire Resistance" button.

3. The digital meter reading indicates the resistance in ohms. Bend and manipulate the power cord of the device at the plug and grommet to see if there is an intermittent reading. If the meter reads overrange, the ground wire may be broken, or the device may be double insulated. Check the manufacturers literature to determine if the device is double insulated, the ground wire resistance cannot be measured. Record this information on the inspection form.

   If the device is not double insultated and the Model 260 reads "Overrange", the device is defective. Record the reading and tag accordingly.

6.5 ECG Lead Leakage Measurement

1. Push the "ECG Lead Leakage" button. (All ECG leads should be attached to the 26

2. Rotate the ECG lead selector switch to each position. Record the highest reading and the lead selected in each of the following power configurations:

   Normal Polarity - Ground
   Reversed Polarity - Ground
   Reversed Polarity - No Ground
   Normal Polarity - No Ground

   Please Note: All the tests can also be done with Open Neutral.

   Note: The ECG Machine Selector Switch may be on any lead for all ECG Lead Leakage and Isolation Tests.

3. The operator may, upon his own discretion, use the "All Leads Leakage"

selector, rather than test each individual lead. This will provide a cumulative figure of all the lead leakages.

Note: If the "Danger" light is activated put the polarity switch in center "OFF" position, disconnect the device and label accordingly. Discontinue testing.

6.6 ECG Lead Isolation Measurement

WARNING: During this test sequence, there is 120 volts through 300K ohms applied to the universal ECG jacks. Do not touch these jacks when the "Lead Isolation" button is pushed.

1. Push the "ECG Lead Leakage" button.
2. Put the Polarity Switch on "NORM".
3. Put the ground switch on "Ground".*
4. Put the ECG selector switch on RL.
5. Push the ECG "Lead Isolation" button.

   Record the reading minus the "260 Isolation Factor" measured in the set up procedure of Section 6.2, step 6.

   If the 260 reads in excess of 300 microamperes, the ECG unit may not be isolated. Discontinue this test and refer to the ECG manual to determine isolation. Label the ECG unit accordingly (either "not isolated" or "defective").

6. Rotate the ECG selector to the next ECG lead and repeat step 5.

   It is not necessary to record inter-lead isolation values.

*Ground Switch is on "Ground" to insure maximum leakage reading.

6.7 Current Consumption

1. Press "Chassis Leakage" selector.
2. Press amps selector.
3. Turn device under test on and read current draw directly in amps.

6.8 AAMI Reading Comparison

The standard for ECG isolation according to the Association for the Advancement of Medical Instrumentation is 20UA for ECG leads using 120 volts through a 120K ohms limiting resistor. The Model 260 uses a 300K ohm limiting resistor to provide operator safety. This results in different readings than those provided by the AAMI recommended technique. The isolation test current according to AAMI can be calculated from the current measured with the Model 260. A chart is also provided with equivalent AAMI readings.

Im = meter reading during isolation tests

I_f = isolation factor measured with no leads attached

I_{260} = 260 isolation leakage current

I_{AAMI} = AAMI isolation leakage current

$$I_{260} = I_m - I_f$$

$$I_{AAMI} = \frac{120\ I_{260}}{120-(1.8 \times 10^{+5})\ (I_{260})}$$

Example: When the "Lead Isolation" test button is pushed, Model 260 reads: 5.0 with no leads attached (I_f) and 15.0 with leads attached (I_m), then I_{260} = 15-5 = 10μA.

$$10\mu A(I_{260}) = 1 \times 10^{-5} \text{ Amperes}$$

$$I_{AAMI} = \frac{(120)\ (1 \times 10^{-5})}{120-(1.8 \times 10^{+5})\ (1 \times 10^{-5})}$$

$$I_{AAMI} = \frac{120 \times 10^{-5}}{120-(1.8 \times 10^{+5})\ (1 \times 10^{-5})}$$

$$I_{AAMI} = \frac{120 \times 10^{-5}}{120 - 1.8}$$

$$I_{AAMI} = \frac{120 \times 10^{-5}}{118.2} = 1.015 \times 10^{-5} = 10.1\mu A$$

CHART 1

I_{260}	I_{AAMI}
5.0	5.0
10	10.0
15	15.4
20	20.6
30	31.4
40	42.6
50	54.1
60	66.0
70	78.2
80	90.9
90	104
100	118
120	146
140	177
160	210
180	240
200	263

NOTE: In the range of importance, the differences are less than 5% which is within realistic measurement accuracies. I_{260} and I_{AAMI} can be considered equal below 30μA.

7.0 TESTING PORTABLE DEVICES USED IN ISOLATED POWER AREAS

7.1 Introduction

It is recommended that devices used in areas with isolated power systems be tested in areas with a grounded (conventional) power system. The isolated power system (IPS) can decrease leakage current values substantially. In addition, leakage current standards are defined for grounded power system operation.

However, testing can be done either outside or inside the IPS area. Section 7.2 describes testing the devices using a grounded power system and Section 7.3 describes testin in the IPS area.

The optional adapter described in Section 2.4 are used to adapt the IPS special power connectors for use with the Model 260.

7.2 Testing IPS Devices on a Grounded Power System

1. Remove the device under test to an area with ground referenced power.

2. Plug the device into an adapter cord (Models NF23/2, NF24/2, NF25/2) with a female explosion-proof receptacle on one end of the adapter cord. Connect the other end of the adapter cord to the receptacle on the front panel of the Model 260.

3. Plug the Model 260 line cord into a wall receptacle.

4. The device can now be tested in accordance with Section 6.

7.3 Testing IPS Devices in the IPS Area

1. Connect the female explosion-proof receptacle of an adapter cord (Models NF23/2, NF24/2, NF25/2) to the male plug of the device under test.

2. Plug the other end of the adapter cord into the Model 260 test receptacle.

3. Plug a male explosion-proof plug from an adapter cord (Models NF23/1, NF24/1, NF25/1) into a receptacle in the IPS area.

4. Plug the line cord of the Model 260 into the female receptacle of the adapter cord of step 3.

5. Proceed as instructed in Section 6.

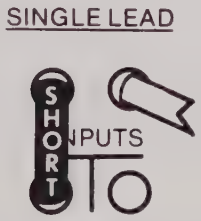
8.0 TESTING PERMANENTLY WIRED DEVICES

8.1 Introduction

The testing of permanently wired devices can be carried out only with the device under test either on or off. (This contrasts with protable units which can plug direclty into the Model 260's front panel receptacle and have receptacle conditions varied by front panel switching.) If an adapter cord is available proceed to step 8.2. If not, Section 9.0.

8.2 Single Lead Set-up

1. Single lead measurement:



Place shorting bar between the top black input jack and the bottom green banana jack.

Connect the single lead to the red input jack.

Note: The shorting bar connects one side of the measuring system to earth ground during chassis leakage measurements and to the 260 receptacle ground pin during ground wire resistance measurements.

2. Attach the large clamp to the single red banana plug on the lead.

3. Plug the Model 260 line cord into a receptacle.

   Note: If the devices to be tested are located in an Isolated Power System Area, refer to Section 7.3 for 1 thru 4 set-up instructions.

4. Turn Model 260 on and verify "Power" light.

5. Push the "Systems Check" button. Verify that:

   a. Analog display reads 10μA.

   b. "Receptacle Check" neon light reads "OK".

Note: 1) The receptacle test is invalid when testing in an Isolated Power Systems Area. An explanation is contained in Section 5.1.

2) The "Insulation" test is not valid for this test, since the device under test cannot be plugged into the Model 260.

6. Attach red clamp to chassis of device under test.

7. Push "Chassis Leakage" current button. Record the recordings with the device on and off.

Note: Readings will be virtually zero if device is well grounded.

8. Push "Ground Wire Resistance". Record reading in ohms.

9. If the device under test has no ECG leads, proceed to the next device. If the unit under test has ECG leads, proceed with step 10.

10. Push "ECG Lead Isolation" button. (No ECG leads should be connected.)

WARNING: There is 120 volts on the universal ECG jacks during this test. Do not contact the jacks while the lead isolation button is depressed. Up to 500μA of leakage current may flow through the ECG jacks.

11. Record the meter reading with the ECG selector on RL. This leakage is internal to the Model 501 and should be subtracted from isolation readings taken in step 18.

12. Connect the ECG leads to the universal adapters by either snapping them on the top or sliding them in the hole and screwing down on them.

13. Push the "ECG Isolation Test" button with the ECG selector on RL. If the meter reads over 300μA, the unit is either not isolated or faulty. Read the ECG Service Manual and dtermine if the unit is isolated. If the unit is not isolated, proceed to step 15. (An isolation test cannot be performed on an unisolated device.) If the unit is isolated, remove from service and mark for repair. If meter reads less than 300μA, proceed to step 14.

14. Record the isolation leakage on each lead, with the "ECG Isolation Test" button pushed. Below 30 microamperes the Model 260 readings can be considered equal to values under AAMI standards. Above 30 microamperes refer to Chart 1, page 6-7 for conversion to AAMI test values. It is not necessary to record inter-lead isolation values.

15. Record the leakage current from each lead with "ECG Lead Leakage" button only pushed.

9.0 DUAL LEAD MEASUREMENTS (MEASUREMENT BETWEEN CONDUCTIVE SURFACES)

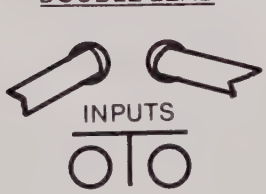
9.1 Introduction

The Model 260 can measure leakage currents, millivolt potentials, as well as resistances between any two points. These measurements are useful under the following circumstances:

1. Checking ground points in a room for point to point resistance and millivolt potentials.
2. Measuring leakage currents and ground wire resistances from devices with 220V or 110V power.
3. Measuring leakage current and ground wire resistances from devices in IPS areas without the use of adapter cords.
4. Making miscellaneous measurements independent of ground.

9.2 Set-Up

1. Remove any shorting bars from the 260 input jacks.



Connect the black lead to the black input jack

Connect the red lead to the red input jack.

2. Connect the appropriate adapters or probes to the other ends of the leads depending on type of measurement to be made.
3. Press the following buttons for measurements indicated:

BUTTON	MEASUREMENT
GRD Wire Resistance	Resistance (ohms)
Chassis Leakage	Potential Difference (millivolts) Leakage Current (microamps)

The measurements are relative to the two points which the lead ends contact and are independent of earth ground.

SECTION 10.0
MEASURING LEAKAGE CURRENT THROUGH THE GROUND WIRE

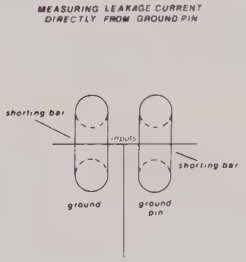
10.1 Introduction

The Model 260 can measure leakage current through the ground wire, providing a quick way to spot check equipment. The readings obtained are identical to the readings that are obtained in Section 6.3 (Chassis Leakage Measurement) and can only be taken on portable devices that can be connected to the Model 260 receptacle.

It is recommended that this test not be used as routine inspection since chassis leakage from exposed metal is the desired measurement paramter. Also to properly test a device the ground wire resistance must be measured and to do this requires a lead to be connected to the chassis. The Model 260 is designed to take advantage of a one lead set up to make all measurements. However, for quick spot checks, leakage current through the ground wire can be measured easily.

10.2 Set-Up

1. Model 260



Connect a shorting bar between the black input and green ground jacks and red input and green ground pin jack.

2. Plug the device to be tested into the Model 260 test receptacle.

10.3 Measurement

1. Put the ground switch on "No Ground". This is necessary for any measurement in this section.

2. Push "Chassis Leakage" button.

3. Change 260 receptacle conditions and take readings with the device ON/OFF with NORMAL and REVERSED polarity.

CAUTION: If the "Danger" light is activated, place the polarity switch on center "OFF" position. Unplug the device, properly tag and remove from service.

11.0 Principles of Operation

11.1 Introduction

The operation of the Model 260 can be divided into four systems.

Microamp/Millivolts Amplifier
Ohms
Power Supply
Input Switching and Test Receptacle

A brief description of each section follows.

11.2 Microamp/Millivolt Amplifier

The input of the Microamp/Millivolt section, with over 20 megohms of input impedence, is in parallel with the AAMI test load.

The signal is amplified by an operational amplifier in the non-inverting mode. The gain of this amplifier is controlled by an auto range circuit which is driven by the output of this entire section.

The next two sections perform the R.M.S. calculations, with the last section providing low pass filtering for proper operations of the auto-range circuit. The output of this filter is connected to the meter on the front panel.

11.3 Ohms

Ohms are measured by feeding a known constant current through the unknown resistance and measuring the voltage drop with the millivolt meter described in the previous section. The gain of the first operational amplifier however is changed for A.C. so that 60 HZ noise is greatly reduced.

11.4 Power Supply

The power supply consists of a transformer, providing isolation from the power mains, which are connected to + and -5 volt regulators. In addition, an isolation transformer for the ECG lead isolation test is used for safety.

11.5 Input Switching and Test Receptacle

The input switching provides all connectors needed for each function. The switches are interlocked for one button operation and have mechanical lockout to prevent damage or misinterpreted readings.

The 260 also allows the operator to change the A.C. power supply configuration to the device under test. The test receptacle is connected to the A.C. supply line by toggle switches which alter the polarity and ground.

The A.C. supply line is connected to the receptacle check circuit during "Systems Check". This circuit checks the polarity of the supply line by a resistor network and three neon lights.

If the polarity switch for the A.C. test receptacle is in the OFF position, a simple megohm tester checks the hot to ground and hot to neutral resistances of the device under test in the systems check mode. If either one of these resistances are less than 1 megohm, the proper L.E.D. will change from green to red.

TESTING ISOLATED POWER SYSTEMS/GFIs

12.1 General

The Bio-Tek Model 260 when used with a Bio-Tek Model 12 can thoroughly test LIMs for the following:

Macro Fault - Measures the total leakage in the IPS unit on Line A or B. Macro Fault reads directly on the Model 260 from 0-25mA.

Trip Point - Tests on LIMs audible and/or visual alums by simulating a variable fault to ground. Leakage to ground is taken from side A and B independently. Trip Point reads directly on the calibrated Model 12 indicator.

Trip Point-Balanced - Tests the trip point of the LIM under simultaneous fault conditions. The fault current/resistance is varied simultaneously on both lines A and B. Allows calibration of LIM trip point. Reads directly on the calibrated Model 12 indicator.

Opposite Wire Leakage - Performed at the LIM trip point to measure the actual leakage from the non-faulted conductor if human contact was made at the LIM Trip Point. This test includes both excisting macro-fault and simulated fault. Reads directly on the Model 260 from 0-25mA.

12.2 Set-up

1. Put the polarity and ground switch in normal position.

2. Plug the Model 12 into the front of the Model 260's receptacle and input jacks. Confirm that Model 12 is completely plugged in.

3. Connect the plug of the Model 260 to the appropriate adapter for connection to the isolated power system.

12.3 Operation

1. Push the "Chassis Leakage" button on the Model 260.

   Note LIM meter reading for use in results.

2. Push the Macro Fault Side A button on the Model 12.

   Results: The Model 260 will indicate the total leakage to ground of the isolated power system. This reading should be approximately equal to the LIM meter indicator reading.

   Requirements state that a LIM should not introduce greater than 1 milliamp of leakage to the system. Adding a factor for leakage due to wiring and devices connected could bring the Macro Fault up to 1.5 milliamps (1500μA).

3. Push the Macro Fault Side B button, the results should be the same as step 2.

4. Rotate the Model 12's Trip Point knob fully counter clockwise.

5. Push Trip Point A button. Rotate Model 12's trip point knob back slowly clockwise.

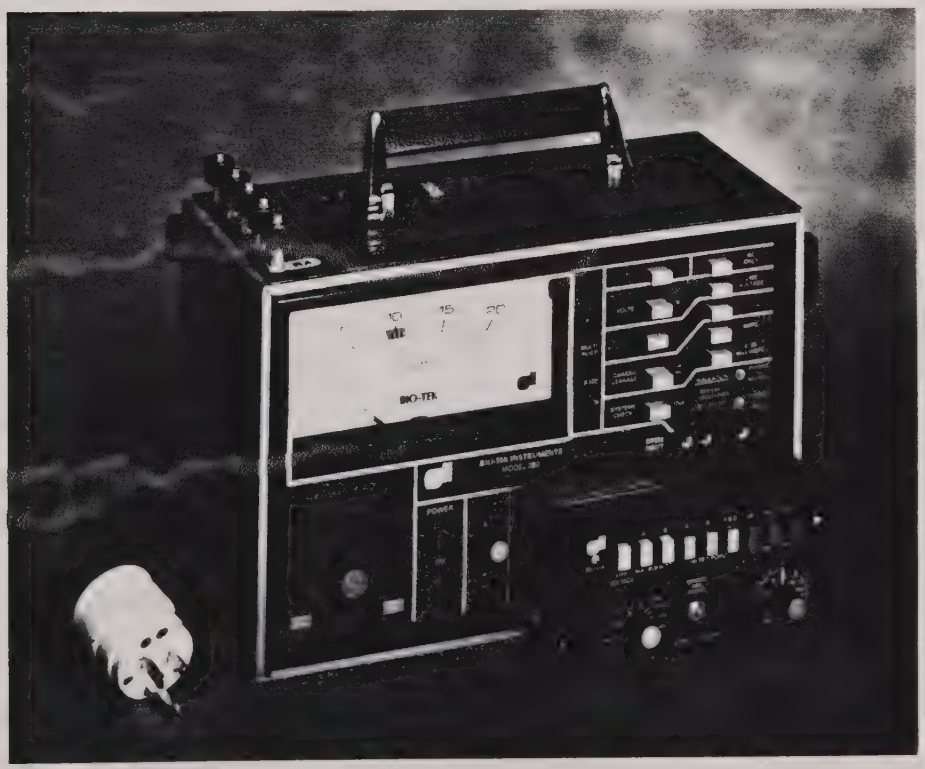
6. Record the knob reading when the alarm sounds.

7. Push Opposite Wire Leakage button. The reading on the safety analyzer indicates the total leakage at the Trip Point. This reading should be approximately the knob indicated leakage, plus the macro fault leakage measured in step 2. Record the reading.

8. Repeat steps 4, 5, 6, and 7 with side B button pushed.

9. Push LIM trip point A + B. This introduces a balanced fault on each line to ground simultaneously. The reading should be similar to reading obtained in side A and B tests. This system can be used to calibrate the LIM trip point of the LIM.

Please Note: Isolated Power Test Forms may be ordered from Bio-Tek. Call Sales Department at 800-451-5172 for more information.



Model 260 with Model 12 Isotester

APPENDIX A
ISOLATED POWER SYSTEMS

The isolation transformer functions to transform an earth referenced power distribution system into a non-earth referenced system. The voltage of either wire of an isolated power system, with respect to ground, is ideally zero. This means that a person standing with bare feet in 6 inches of water in the basement can touch either power conductor of an isolated power system, and not be injured.

The theory of operation of an isolation transformer is based on transforming electric current flow into a magnetic field and the converting the field back into current. This process provides the isolation.

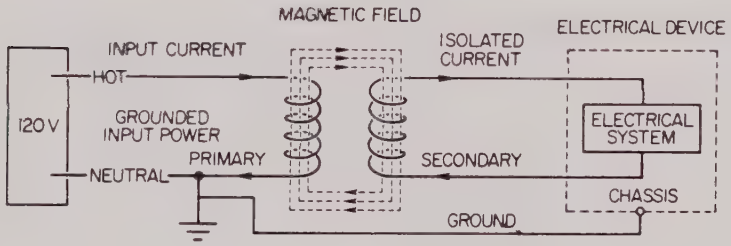
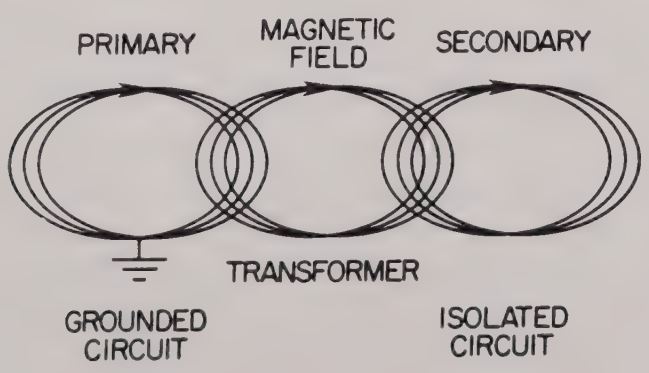


FIGURE 1

The grounded power system provides current which travels in a closed path through the primary of the transformer. This current creates a magnetic field in the transformer that also passes through the wires on the secondary. The magnetic field is a closed system that travels in a circular path. The current in the secondary of the transformer is also a closed path system. The net result is three circular systems that end up isolating two parts.



13.0 TESTING GROUND FAULT INTERRUPTORS

13.1 General

The Model 12 option allows the Model 260 to thoroughly test Ground Fault Interruptors for actual trip points.

13.2 Set-up

1. Attach Model 12 to the 260 (see section 12.2)

2. Plug Model 260 into the GFI under test.

13.3 Operation

1. Turn Model 12 GFI Trip Point knob fully counter clockwise.

2. Select appropriate range on the Model 12. Ranges are: 40 to 200µA, .1 - 1.0mA, and 1 - 10mA.

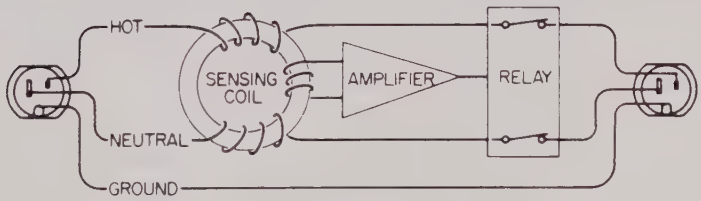
3. Turn GFI Trip Point knob slowly clockwise until GFI is tripped. Note knob reading and record.

APPENDIX B
GROUND FAULT INTERRUPTERS

Ground fault interrupters are automatic switches that disconnect the power if there is an excessive leakage current. Ground fault interrupter systems consist of a sensitive sensory system that controls switching relays.

The sensing circuit has nothing to do with ground. The ground fault interrupter uses a magnetic torroid around which several turns of the hot and neutral conductors are wrapped. The hot and neutral conductors are wrapped in the same direction. When current is flowing, it produces a magentic field in the magnetic material. The current in the hot and neutral conductors, travels in the exact opposite direction. So if the current in the hot and neutral is equal, which it should be, the net magnetic field is zero because the magnetic field produced by the hot wire is exactly cancelled by the magnetic field created by the current flowing in the opposite direction in the neutral wire.

GROUND FAULT INTERRUPTOR



Also wrapped around the magnetic core is a sensing winding. If the current in the hot and neutral is not equal, then there will be a net magnetic field that the sensing winding will detect. This is amplified and used to control the relays.

If the current in the hot and neutral conductor is not equal, then it must be going to ground via another route. The neutral is the correct return path for the current. If it is not returning via the neutral, it is returning to ground through a conductive medium such as a human being.

The basic principle of isolated power systems is that current must travel is a closed path. Using this principle, the following diagram indicates why a person doesn't receive a shock when connected to either power conductor.

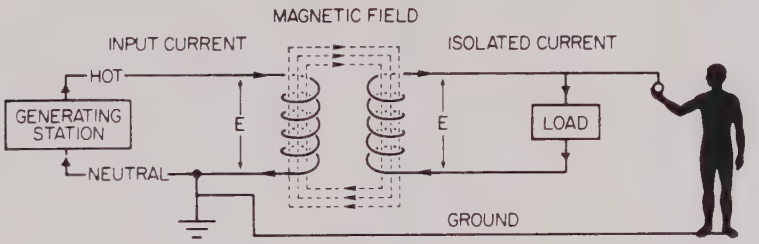
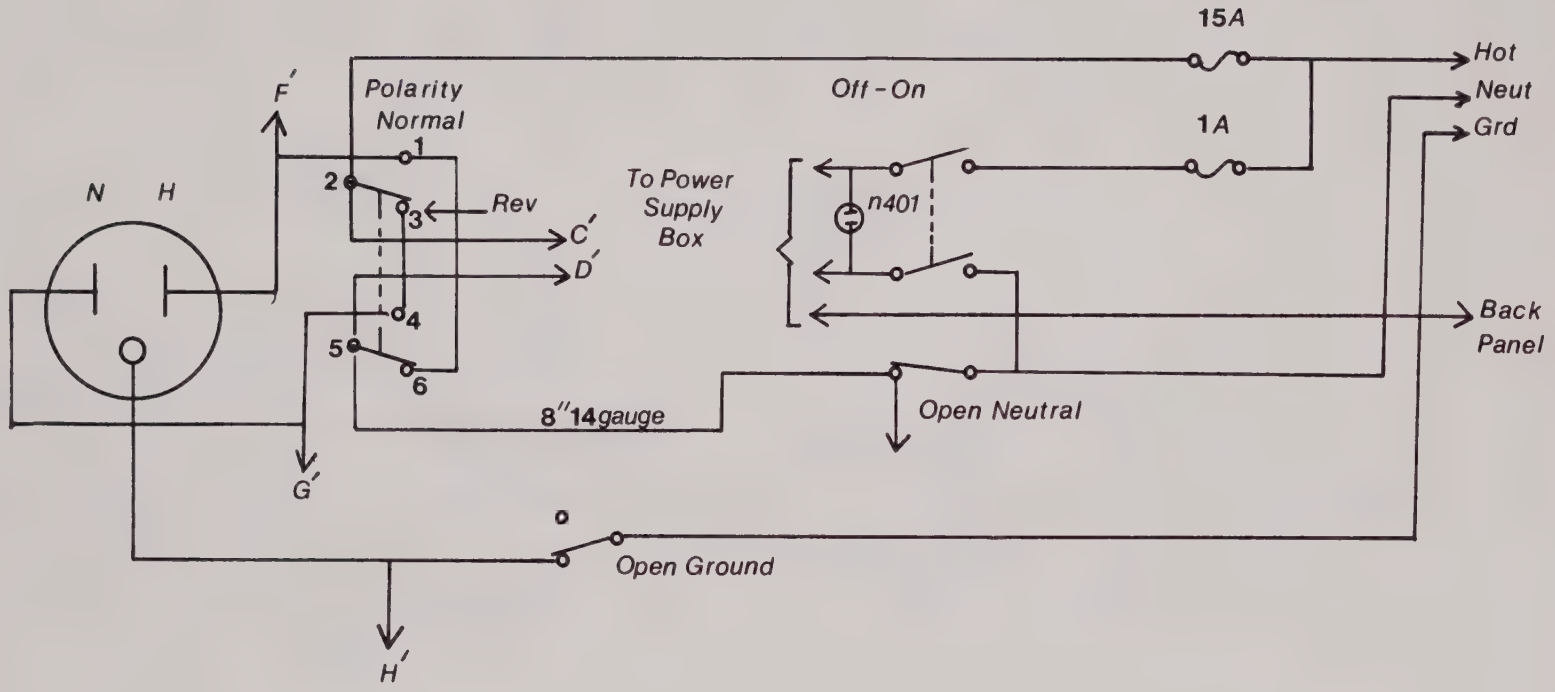


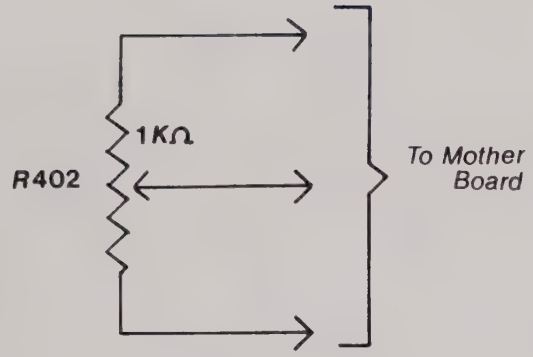
FIGURE 3

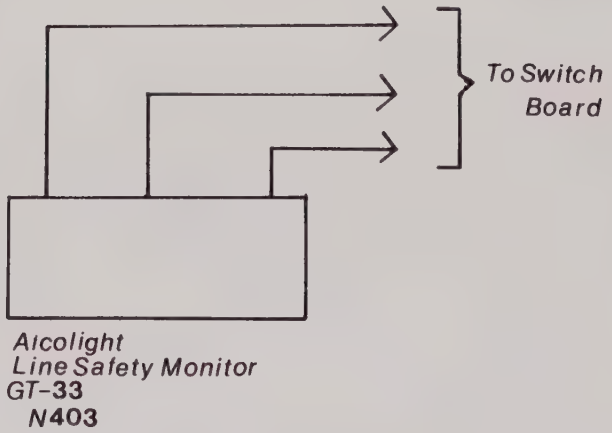
There is no closed pathway for the current to flow through a person who is touching the wire. The transformer blocks the current from flowing around in a complete circle.

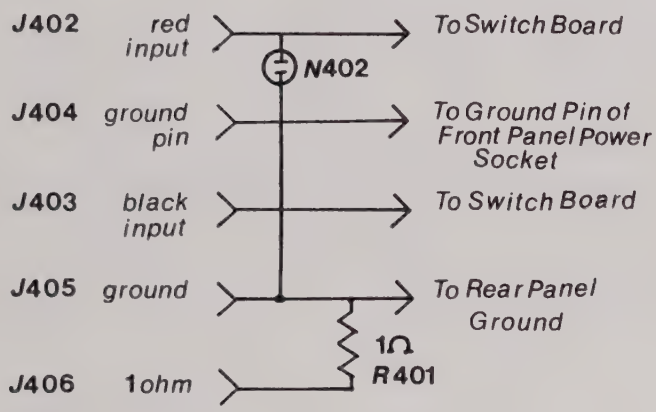


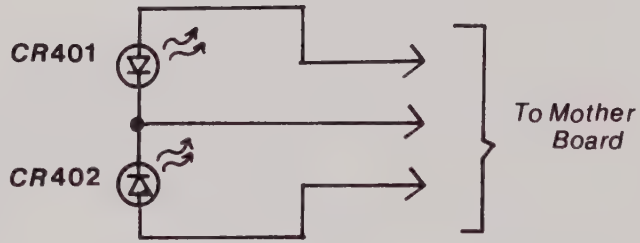
TOLERANCES (EXCEPT AS NOTED)	REVISIONS			260 A.C. WIRING DIAGRAM		
DECIMAL ±	NO.	DATE	BY			
FRACTIONAL ±	1	9-8-80	KDM			
ANGULAR ±	2					
	3			DRAWN BY	SCALE	MATERIAL
	4			CHK'D	DATE	DRAWING NO.
	5			TRACED	APP'D	

TELEDYNE POWER 18AE-01E-8½X11



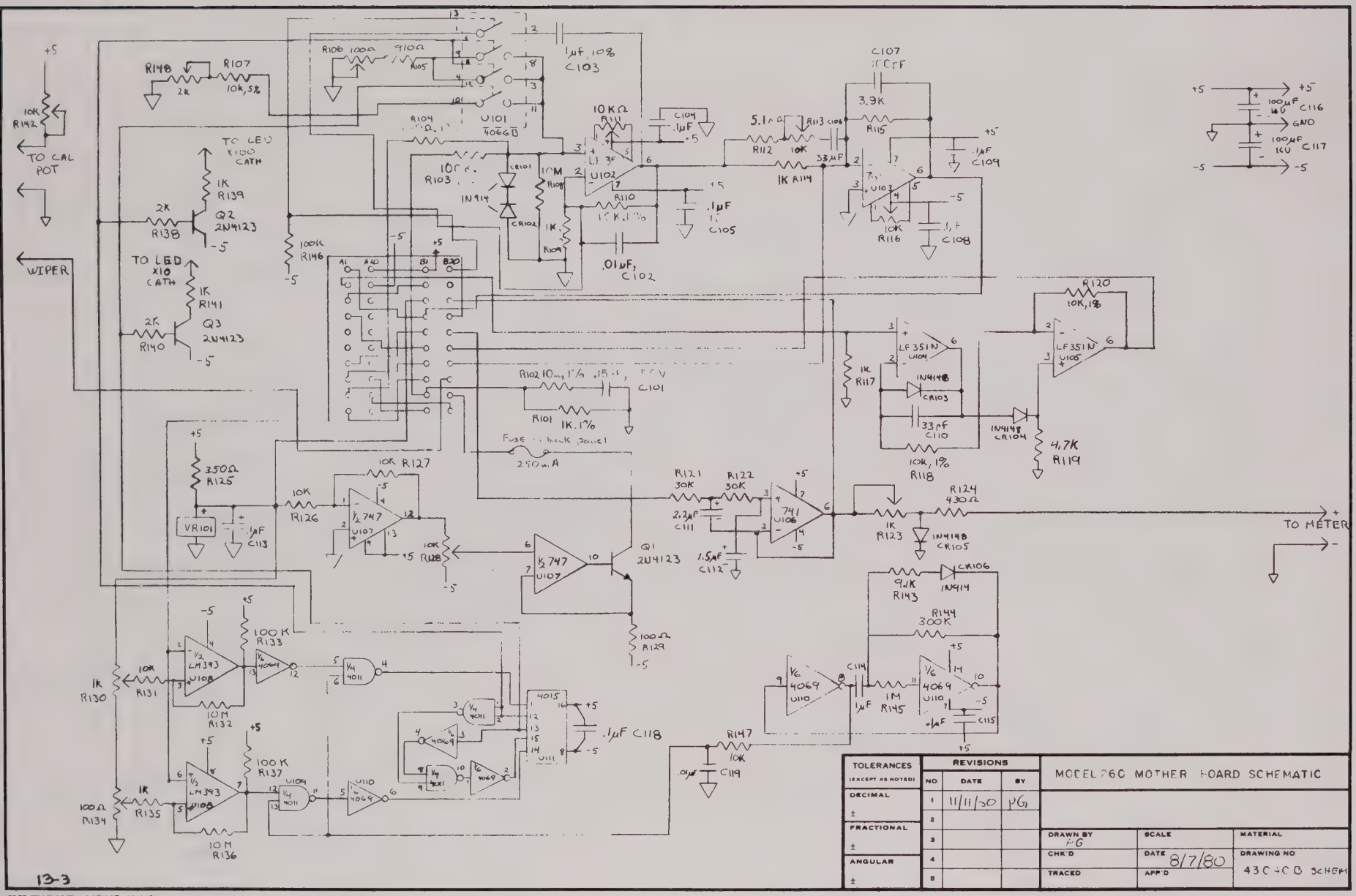






TOLERANCES (EXCEPT AS NOTED)	REVISIONS			260 FRONT PANEL		
DECIMAL ±	NO.	DATE	BY			
	1	9.8.80	KDMC			
FRACTIONAL ±	2					
	3			DRAWN BY	SCALE	MATERIAL
ANGULAR ±	4			CHK'D	DATE	DRAWING NO.
	5			TRACED	APP'D	

TELEDYNE POST 18AE-01E—8½X11

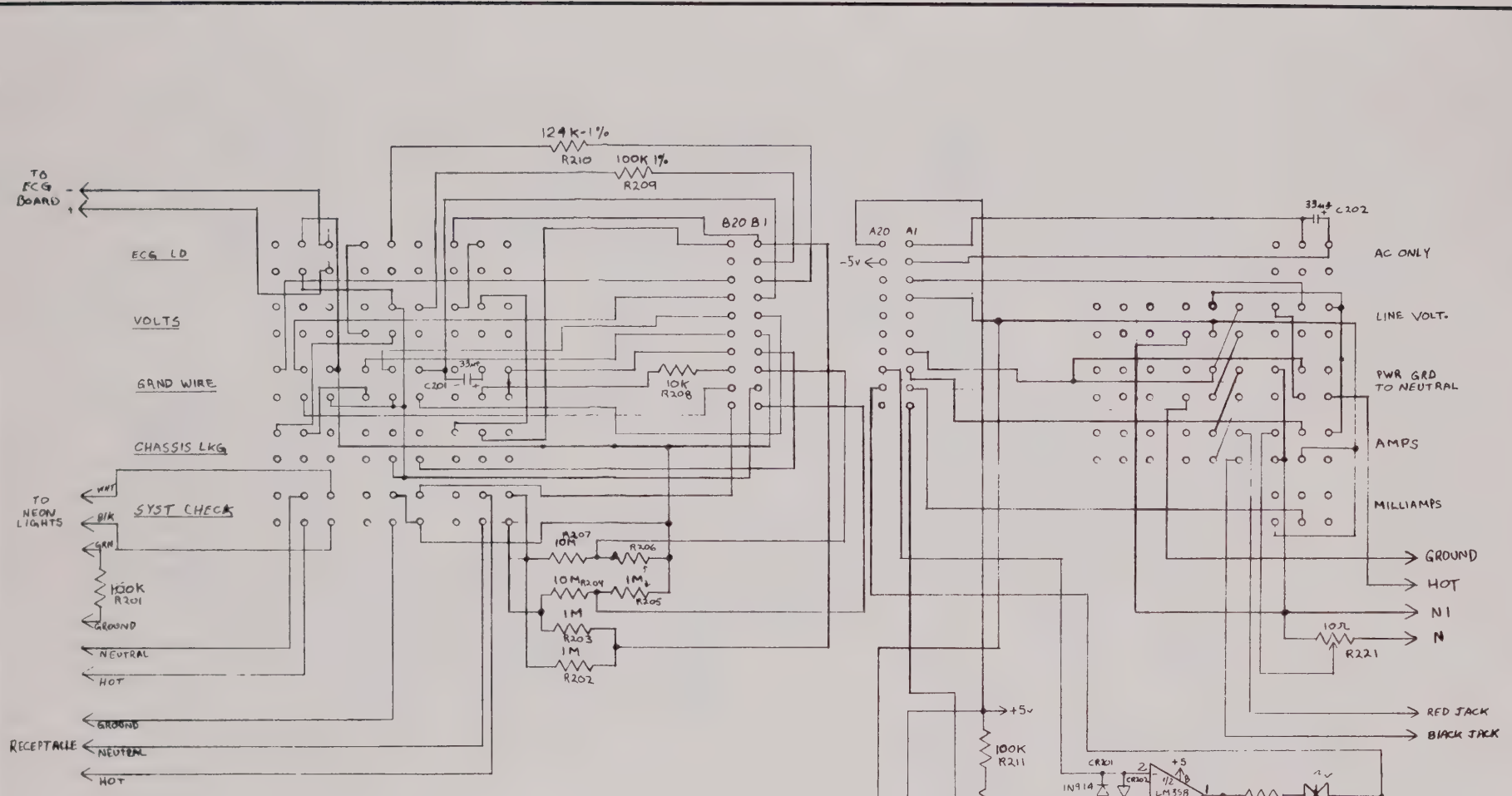


TOLERANCES (EXCEPT AS NOTED)	REVISIONS			MODEL 260 MOTHER BOARD SCHEMATIC		
DECIMAL ±	NO	DATE	BY			
	1	11/11/80	PG			
FRACTIONAL ±	2					
	3			DRAWN BY PG	SCALE	MATERIAL
ANGULAR ±	4			CHK'D	DATE 8/7/80	DRAWING NO 430-40B SCHEM
	5			TRACED	APP'D	

13-3

TELEDYNE POST 18AE-10E-12X18

14-3



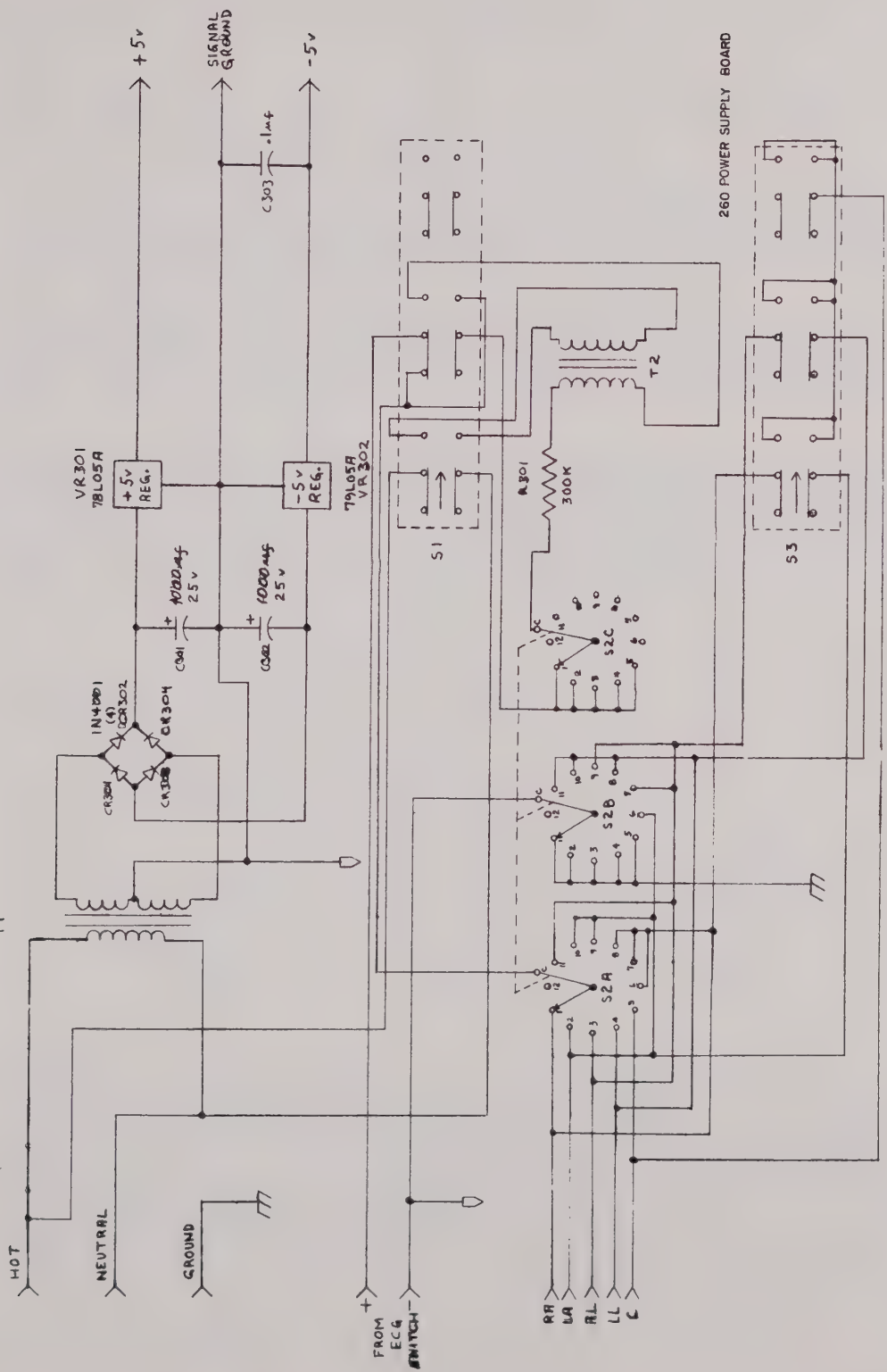
TOLERANCES (EXCEPT AS NOTED)	REVISIONS NO	DATE	BY
DECIMAL ±	1		
FRACTIONAL ±	2		
ANGULAR ±	3		
	4		
	5		

Model 260

Switch Board Schematic

DRAWN BY	SCALE	MATERIAL
P.G.		
CHK'D P.M.W.	DATE 7-15-80	DRAWING NO
TRACED	APP'D	

TELEDYNE POST 18AE 10E-12X18


+5v
SIGNAL GROUND
-5v
.1uf
C303
260 POWER SUPPLY BOARD
VR301
78L05A
+5v REG.
-5v REG.
79L05A
VR302
1000uf 25v
C301
C302
IN4001 (4)
CR301
CR302
CR303
CR304
T1
T2
S1
S2A
S2B
S2C
S3
RJ01
300K
HOT
NEUTRAL
GROUND
FROM ECG SWITCH
RA
LA
RL
LL
C

CALIBRATION PROCEDURE

Model 260

1. Before turning unit on, rotate R130 and R134 fully counter clockwise.

2. Turn unit on and push "Chassis Leakage" button.

3. Short red and black jacks together, and apply DVM between R114 (pin 6 U102 side) and ground. Adjust R111 for 0.00 volts. Change DVM to R115 (pin 6 U103 side) and adjust R116 for 0.00 volts.

4. Connect DVM between R103 (pin 3 U102 side) and ground with input still shorted and push "Systems Check" button on 260. DVM should read 10mV ± .5mV. Adjust R123 so 260 meter reads what DVM does. Disconnect shorting bar and DVM from 260.

5. Push "Chassis Leakage" button and input into the red & black jacks sufficient current so the 260 reads 25.5 on the X1 scale, (no LED on). Rotate R130 clockwise until meter changes to X10 scale. (To check setting, back R130 off ½ turn and readjust power supply for 25.5 on X1 scale and readjust R130.) Now adjust supply to read .15 on X10 scale. Adjust R134 clockwise until meter changes to X1 scale (Check setting the same way on this adjustment as on the X10 range.)

6. While applying DC microamps, push AC only button and the 260 should read ≈ 0.

7. Apply 1.00V DC (260 on X100 range) between red and black jacks and adjust R106 so the 260 meter reads 10.0.

8. Apply 100mV AC rms with 0V DC offset between red and black jacks. Adjust R113 so meter reads 100μA (10.0 on X10 range).

9. Push "Volts" button and push "Line Voltage" button. 260 should read line voltage.

10. While on "Volts" function, input the following AC voltages and record the results.

X1 Range	X10 Range	X100 Range
(no LED on)	10V	120V
1V	20V	
2V		

11. Adjust "Ohms Calibration" knob on front panel so that wiper is in the center of the pot (the pointer should be pointing at 12 o'clock). Push "Grd Wire Resistance" button and short out the green and black jacks, and run a jumper wire from the red jack to black jack and adjust R142 so meter reads zero. Move jumper to black jack under calibration knob and adjust R128 to read 1.0 (on ohms scale.) Move jumper back to black input jack and adjust R142 to read 0 and then connect jumper back to 1 ohm circuit and again adjust R128 to read 1. Alternate back and forth until both are accurate. While on grd wire resistance, apply .5 and 1.0 ohms and take readings.

12. Push the "Chassis Leakage" button, and input the following values of DC current: 5mA, 10mA, 15mA, and 20mA. Record your readings.

13. Assure that the polarity switch is in the "Off" position. Apply a 1MΩ resistor between the Hot and ground of the test receptacle on the 260. Adjust R212 until the "Hot to chassis" LED is pink. Move the 1MΩ resistor to the neutral and ground pins and adjust R217 until the "Neutral to Chassis" LED is pink.

ASSEMBLE THE 260 INTO ITS CASE

1. Make provisions to reverse polarity and break ground on power going to the 260. Assure that the receptacle check lights work properly in "Systems Check" mode.

2. Plug receptacle tester into test receptacle on 260 and assure that the normal-Off-Reverse, Open Neutral and Open Ground switches on the 260 are working properly.

3. Push "Chassis Leakage" button and make provision to draw a known amount of current from 260 test receptacle. Push the "Amps" button and assure that the 260 reads the proper amount of current (±3% of full scale).

4. Apply 1.0V DC between RA and ground, LA and ground, RL and ground, LL and ground, and C/V and ground. Push "ECG Lead Leakage" button and rotate "ECG Lead Select" switch through RA, LA, RL, LL, and C. 260 should read 1000μA ±30μA on all settings.

SELECTED COMPONENTS - MODEL 260

ASSEMBLY	SCHEMATIC DESIGNATION	DESCRIPTION	BIO-TEK PART NO.
FRONT PANEL	N401	Neon Light	01008
	N402		
	N403	OK Neon Light	01009
		Red Lense w/lock ring	03005
		Knurled nut	14009
		4-40 locknut	15002
		4-40 nylon nut	18004
		#4 flanged washer	18008
	R401	1Ω ¼watt 1%	32041
	R402	1K panel Pot	36001
	J402	Red Banana Jack	42001
	J403	Black Banana Jack	42002
	J404	Green Banana Jack	42004
	J405		
	J406	Brown Banana Jack	42005
		#8 Spade Connector, 16-14	42025
	J401	Hospital Grade Receptacle	42047
		.250 Quick Connector, 16-14	42053
		.250 Quick Connector, 12-10	42056
		Cable Ties	42058
		5 Position Connector	42071
		.205 Quick Connector 22-18	42078
		Sub-Panel	44023
		Overlay	44079
		11mm Knob	45008
		Red Cap	45010
		Red Pointer	45013
		½" Threaded spacer	49017
		Right Angle Bracket	49018
		3" Threaded spacer	49042
	S404	SPDT Rocker Switch	54002
	S403	SPST Toggle Switch	55001
	S401	DPST Toggle Switch	55002
	S402	DPDT Toggle Switch	55003
		260 Meter	92007
		Meter Bezel	92008
	CR401	Red L.E.D.	03004
	CR402		
		3 pin connector Female	42073
		Crimp Terminal for 42073	42074
		Printed Circuit Board	43040
		Pop Rivots	19003
	CR103	Diode, IN4148	21004
	CR104		
	CR105		
	CR106		
	CR101	Zener Diode, 4.7 volt	22027
	CR102		
	U103	OpAmp, 741	23006
	U106		

SELECTED COMPONENTS - MODEL 260

ASSEMBLY	SCHEMATIC DESIGNATION	DESCRIPTION	BIO-TEK PART NO.
	U107	Dual OpAmp, 747	23016
	U108	Comparator, LM393	23028
	U102	OpAmp, LF351AN	23031
	U104		
	U105		
	U101	CMOS 4066	25001
	U110	CMOS 4069	25012
	U111	CMOS 4015	25017
	U109	CMOS 4011	25021
	Q1-3	NPN Transistor, 2N4123	26002
	VR1	1.26 Volt Regulator	28009
	R129	100Ω ¼ watt 5%	31101
	R114	1K ¼ watt 5%	31102
	R135		
	R139		
	R141		
	R117		
	R107	10K ¼ watt 5%	31103
	R126		
	R127		
	R131		
	R147		
	R133	100K ¼ watt 5%	31104
	R137		
	R146		
	R145	1meg. ¼ watt 5%	31105
	R108	10meg. ¼ watt 5%	31106
	R132		
	R136		
	R138	2K ¼ watt 5%	31202
	R140		
	R121	30K ¼ watt 5%	31303
	R122		
	R114	300K ¼ watt 5%	31304
	R125	360Ω ¼ watt 5%	31361
	R115	3.9K ¼ watt 5%	31392
	R124	430Ω ¼ watt 5%	31431
	R119	4.7K ¼ watt 5%	31472
	R112	5.1K ¼ watt 5%	31512
	R105	910Ω ¼ watt 5%	31911
	R143	9.1K ¼ watt 5%	31912
	R103	100K ¼ watt 1%	32030
	R110	10K ¼ watt 1%	32042
	R118		
	R120		
	R109	1K ¼ watt 1%	32047
	R102	10Ω ¼ watt 1%	32049
	R104	100Ω ¼ watt 1%	32100
	R107	11K ¼ watt 1%	32176
	R101	1K ¼ watt 1%	33013
	R106	100Ω 10T Pot	34002
	R134		

SELECTED COMPONENTS - MODEL 260

ASSEMBLY	SCHEMATIC DESIGNATION	DESCRIPTION	BIO-TEK PART NO.
	R123	1K 10T Pot	34004
	R130		
	R111	10K 10T Pot	34005
	R113		
	R116		
	R128		
	R142		
		#10 ring connector, 22-18	42017
		5 pin header	42050
		.250 Male Tabs	42063
		Dual 10 Edge Connector	42065
		#8 Spade Connector, 22-18	42069
		5 Position Connector	42071
		3 Pin Molex Header	42096
	C116	100µf Cap, Electrolytic	81007
	C117		
	C106	33µf Cap, Tant.	82002
	C114	1µf Cap, Tant.	82005
	C111	2.2µf Cap, Tant.	82006
	C112	1.5µf Cap Tant.	82007
	C110	33pf Cap, Disc.	83001
	C107	100pf Cap, Disc.	83002
	C102	.01µf Cap, Disc.	83007
	C119		
	C104	.1µf Cap, Disc.	83009
	C105		
	C108		
	C109		
	C113		
	C115		
	C118		
	C101	.15µf Cap, Foil	84004
	C103	1µf Cap, Foil	84009
10mm SWITCH BOARD		Printed Circuit Board	43039
	DS201	LED, XC5491	03006
	DS202		
	CR201	Diode, IN4148	21004
	CR202		
	CR203		
	CR204		
	U201	Op Amp, LM358	23027
	R213	10K ¼ watt 5%	31103
	R218		
	R211	100K ¼ watt 5%	31104
	R216		
	R214	10Meg. ¼ watt 5%	3-106
	R219		
	R215	330 ¼ watt 5%	31331
	R220		
	R221	10Ω 10T Pot	34001

SELECTED COMPONENTS-MODEL 260

ASSEMBLY	SCHEMATIC DESIGNATION	DESCRIPTION	BIO-TEK PART NO.
	R212	10K 10T Pot	34005
	R217	5 Position Header	42050
		Grey Button	45016
		Dog Bone Spacer	49028
		7 Station Switch	52013
	C202	33µf Cap, Tant.	82002
	C203	.1µf Cap, Disc.	83009
	C204		
15mm SWITCH		Printed Circuit Board	43038
BOARD	R208	10K ¼watt 5%	31103
	R201	100K ¼watt 5%	31104
	R202	1Meg. ¼watt 5%	31105
	R203		
	R205		
	R206		
	R204	10Meg. ¼watt 5%	31106
	R207		
	R209	100K ¼watt 1%	32030
	R210	124K ¼watt 1%	32175
		10 Position Header	42039
		.250 Female connector 22-18	42086
		Grey Button	45016
		Dog Bone Spacer	49028
		5 Station Switch	52009
	C201	33µf Cap, Tant.	82002
ECG PC BOARD		Printed Circuit Board	43042
		4-40 x 3/16" PH Screw	12019
		4-40 x 1¼" PH Screw	12034
		4-40 Locknut	15002
		#4 Internal Lockwasher	16006
		Pop Rivot	19003
	CR301	Diode, 1N4001	21002
	CR302		
	CR303		
	CR304		
		+5 Volt Regulator, 78L05A	23026
		-5 Volt Regulator, 79L05A	23029
	R301	300K ¼watt 5%	31304
		5 Position Header	42050
		.250 Male Tabs	42063
		Red Button	45017
		Right Angle Bracket	49018
		Dog Bone Spacer	49028
		Rotary Switch w/stopper & nut	51013
		4 Pole Momentary Switch	52011
		6 Pole Push-Pull Switch	52021

SELECTED COMPONENTS-MODEL 260

ASSEMBLY	SCHEMATIC DESIGNATION	DESCRIPTION	BIO-TEK PART NO.
		Isolation Transformer	61012
		Signal Transformer	61013
	C301	1000µf Cap, Electrolytic	81009
	C302		
	C303	.1µf Cap, Disc.	83009
PCB TO FRONT PANEL		2-56 x ¼" PH Screw	12001
		2-56 Brass Nut	14002
		#10 Hex Nut	14006
		#10 Locknut	15006
		2-56 Lockwasher	16001
		15mm Knob	45006
		Blue Pointer	45014
		Blue Cap	45015
BACK PANEL		Strain Relief Washer	17007
		Pop Rivot	19006
		Pop Rivot	19007
		Hospital Grade Plug	42008
		#8 Ring Terminal 16-14	42027
		Ground Connector	42028
		Back Panel	44083
		Fuse, ¼ amp	46001
		Fuse, 1 amp	46003
		Fuse, 15 amp	46007
		Fuse Holder	46008
		Battery Holder	47006
		Strain Relief	49019
		Cord Wrap	49032
		14/3 Power Cord	71001
		Serial Number Tag	93021
		.250 Quick Connector, 22-18	42086
CASE ASSEMBLY		6-32 x 7/16" PH	12036
		6-32 x 11/16" PH	12037
		#6 Lockwasher	16009
		Flanged Nylon Washer	18014
		Vector Screws	19004
		Pop Rivets	19010
		#6 Ring Terminal 22-18	42034
		5 Position Connector	42071
		Case	44015
		Short Bezel	44016
		Long Bezel	44017
		D-D Washer	44064
		Rubber Feet	44067
		ECG Adapter	48041
		ECG Retainer	48042
		Handle	49029
		Lead Wrap	49041
		Instruction Label	44045

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SELECTED COMPONENTS-MODEL 260

ASSEMBLY	SCHEMATIC DESIGNATION	DESCRIPTION	BIO-TEK PART NO.
ACCESSORIES		¼A Fuse	46001
		1A Fuse	46003
		15A Fuse	46007
		Red Probe	48001
		Large Clamp	48003
		Ground Adapter	48005
		Red Lead 5'	48016
		Black Lead 5'	48017
		Shorting Bar	48037

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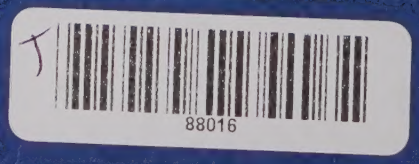

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